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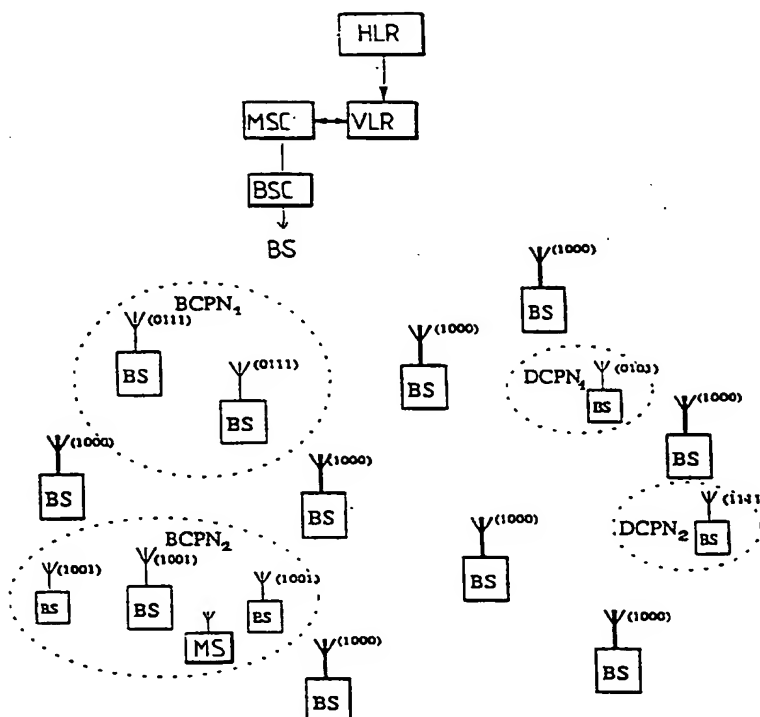
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/FI93/00360 <b>(22) International Filing Date:</b> 9 September 1993 (09.09.93) <b>(30) Priority data:</b> 924060 10 September 1992 (10.09.92) FI <b>(71) Applicant (for all designated States except US):</b> NOKIA TELECOMMUNICATIONS OY [FI/FI]; Mäkkylän puistotie 1, FIN-02600 Espoo (FI). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only) :</b> KAUPPI, Hanna-Maria [FI/FI]; Jämeräntaival 10 F 85, FIN-02150 Espoo (FI). <b>(74) Agent:</b> OY KOLSTER AB; Stora Robertsgatan 23, P.O. Box 148, FIN-00121 Helsinki (FI).		<b>(81) Designated States:</b> AU, JP, NO, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** LOCATION UPDATING IN THE CELLULAR RADIO NETWORK

**(57) Abstract**

The invention relates to a cellular radio network and a mobile radio station. At least part of the mobile stations (MS) are capable of moving, except in a primary network, in at least one other network (BCPN1-2, DCPN1-2) having a location area configuration different from that of the primary network. By means of the invention, the user may prevent manually all location updatings and location updating attempts between the different networks and thus temporarily "lock" the use of the mobile station within a particular network. Not even a location updating attempt into a "foreign network" is made. It is up to the user of the mobile station (MS) to decide when he activates the registration function. The locking function remains activated until deactivation by the user. Subsequent to the deactivation, location updatings between the networks are performed in a normal manner.



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## Location updating in the cellular radio network

Field of the Invention

5 The invention relates to a cellular radio network and especially to an improved location updating in cellular networks.

Background of the Invention

10 Base stations of a cellular radio network broadcast information of themselves and their environment continuously. Such network configuration information may contain for instance a location area identifier, a base station identifier, a base station type identifier and a so-called neighbouring cell  
15 information. When being currently registered to a base station of a particular cell, a mobile station also monitors the quality of the transmission of the base stations indicated by the neighbouring cell information of the current base station and moves to  
20 some of these base stations, if the field strength of the present base station becomes lower. The cellular network knows the location of the mobile station usually with an accuracy of a so-called location area, to which belongs a suitable number of predetermined  
25 cells with their base stations. The location area information sent by the base station indicates to the mobile station to which location area the base station belongs. When the mobile station moves to another cell within the same location area, no location  
30 updating is needed in the cellular network. On the other hand, upon observing on the basis of location area information a change of location area when moving to a coverage area of a new base station, the mobile station initiates a location updating by sending  
35 a location updating request to the cellular net-

work. As a consequence of this location updating request, the cellular network stores the new location area of the mobile station in subscriber registers.

In future, it is conceivable that both public  
5 cellular networks maintained by different operators and several kinds of private Customer Premises Networks (CPN) are utilized, such as for instance Business Customer Premises Networks (BCPN), Domestic Customer Premises Networks (DCPN) and Mobile Customer  
10 Premises Networks (MCPN). In such a situation, it would be preferable for the service of the networks that a mobile station would be capable of registering automatically or manually to these different networks. The public cellular networks and the CPNs  
15 would have separate location area structures. The amount of location updatings would be high in such an environment, with the user moving from one place to another. In particular areas of the network, for instance at the edges of a private cellular network,  
20 signals of the other networks are so strong that a mobile station may try to initiate the location updatings to an external network. Such location updatings are unnecessary and annoying when the user wishes to remain registered within the area of a particular network, irrespective of received signal  
25 level, for instance. Moreover, unnecessary location updatings and location updating attempts cause an unreasonable increase of the signalling load of the network.

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#### Disclosure of the Invention

The object of the present invention is to reduce unnecessary location updatings and location updating attempts and thereby unnecessary signalling in  
35 a cellular radio network having a plurality of sub-

networks.

According to one aspect of the invention, a cellular radio network, comprising a primary network having a first location area configuration, mobile radio stations capable of moving in the primary network from one location area to another, a mobile station starting a location updating procedure in the cellular network each time a changeover from one location area of the primary network to another is observed, is characterized in that at least part of the mobile stations are capable of moving, except in the primary network, in at least one other network having a second location area configuration differing from said first location area configuration, and that the mobile radio station comprises means, which, when activated by the user, temporarily prevent the mobile radio station from initiating location updatings to other networks from the network used at the time of activation.

Another aspect of the invention is a mobile radio station for a cellular radio network, comprising a primary network having a first location area configuration, the mobile radio station being capable of moving in the primary network from one location area to another and starting a location updating procedure in the cellular network each time a changeover from one location area of the primary network to another is observed, characterized in that the mobile station is capable of moving, except in the primary network, in at least one other network having a second location area configuration differing from said first location area configuration, and that the mobile radio station comprises means, which, responsive to an activation by the user, temporarily prevent the mobile station from initiating location up-

datings to other networks from the network used at the time of activation.

By means of the invention, the user may, if desired, prevent manually all location updatings and location updating attempts between the different networks and thus temporarily "lock" the use of a mobile station within a particular network area. The locking of location updatings between networks means that the user may move in the network selected by him from a location area to another, but location updatings from one network to another (e.g. from a BCPN or DCPN to a public network or vice versa, or between public networks) are not performed under any circumstances. Not even an attempt is made to update locations into a "foreign network". The user of the mobile station is entitled to decide when he activates a locking function. For performing a locking function, the mobile station shall be capable of distinguishing the various networks from each other, which may occur for instance by means of a network-specific "locking code" sent by the base stations of the network, whereby all base stations of the same network send the same locking code. Alternatively, a network identifier may be included in the information sent by the base stations already or it may be derived from that. With the locking function activated, the mobile station monitors a change of location area and starts updating the location, if the locking code or the network identifier remains unchanged, but does not perform location updating, if the locking code or the network identifier changes. The locking function remains activated until the user deactivates it, and after that all location updatings between the networks are performed in a normal manner.

By means of the invention, unnecessary location

updatings and location updating attempts between networks are prevented and signalling resources and processing capacity of a cellular radio network are saved.

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#### A Brief Description of the Drawings

The invention will be explained below by means of illustrative embodiments referring to the attached drawing, in which

10        Figure 1 illustrates one cellular radio network according to the invention and

Figure 2 is a general block diagram of one mobile station.

#### 15        A Detailed Description of the Invention

The present invention may be applied in any cellular radio system, as for instance a digital GSM mobile telephone system, an NMT (Nordic Mobile Telephone), a DCT1800, a PCN (Personal Communication Network), a UMC (Universal Mobile Communication), a UMTS (Universal Mobile Telecommunication System), an FPLMTS (Future Public Land Mobile Telecommunications System), etc.

25        As is well-known, the geographic area covered by a cellular radio network is divided into smaller separate radio areas, i.e. cells, in such a way that a Mobile Station MS, when being in a cell, communicates with the network via a fixed radio station positioned in the cell, i.e. via a Base Station BS. The  
30        radio stations MS belonging to the system may roam freely in the system area from one cell to another. However, the cellular radio network maintains files of the location of the mobile station MS in order to be able to route calls terminating to the MS or to  
35        page it for some other reason. The cellular network

typically knows the location of the MS with an accuracy of an area formed by one or a plurality of cells, which area is generally called location area.

5 The base stations of a cellular network broadcast continuity information of themselves and their surroundings, such as a Location Area Identifier (LAI), a Base Station Identifier (BSI), a Base Station Type Identifier (BSTI) and so-called neighbouring cell information. On the basis of the neighbouring cell information broadcast by respective base station BS, an MS registered to a cell knows the neighbouring cells the transmission of the base stations of which the MS should monitor. With weakening field strength of the present base station BS, the MS is registered to the best of these monitored neighbouring base stations. On the basis of the location area identifier (LAI) of the base station, the MS knows to which location area the base station BS belongs. If the MS observes a change of LAI simultaneously with a change of base station BS, i.e. a change of location area is observed, the MS initiates location updating by sending a location updating request to the cellular network. If the location area does not change, the MS does not perform a location updating.

25 A location updating causes an updating of subscriber data in a subscriber register/subscriber registers of a cellular network. In a GSM system, for instance, the cellular network contains at least a Home Location Register HLR, Visitors Location Registers VLR, mobile telephone exchanges MSC and Base Station Controllers BSC, which are connected to the base stations BS of the network. Subscriber location area data are stored in a Visitors Location Register VLR, the number of these registers being typically



one per each mobile telephone exchange. The HLR knows the VLR in the area of which the subscriber is currently located. As for this, the structure and operation of the GSM system are described in more detail in Finnish Patent 921074, for example.

Figure 1 presents a cellular radio network according to the invention, comprising a so-called public primary network and Customer Premises Networks (CPN) of several kinds, such as for instance Business Customer Premises Networks (BCPN), Domestic Customer Premises Networks (DCPN) and Mobile Customer Premises Networks (MCPN). For the sake of clarity, Figure 1 shows only two BCPNs and two DCPNs, the areas and base stations BS of which are illustrated by broken lines, and a group of primary network base stations BS around these CPNs. The public cellular network, i.e. the primary network, may be a conventional mobile telephone network, which offers the same services to all customers within the operating area of the entire cellular network. The CPNs again may be any other cellular networks situated in the area of the primary network or bounded by the primary network at its edges. Such CPNs are typically private, for instance business or corporation systems, and their radio coverage areas cover a relatively local area, e.g. a building site, a building or part thereof, such as one floor or office. Such CPNs may also be called small, sub, local or complementary networks, depending on their configuration and relation to the primary network in each particular case. As to the invention, the configuration of these other networks is not essential, if only at least part of the subscribers are able to use both the primary network and at least one CPN.

As stated earlier, the primary network and each

CPN have separate location area structures, i.e. separate location areas. From this follows that the number of location updatings increases considerably in this kind of network environment with a mobile station MS moving from one place to another. Part of the location updatings and location updating attempts are unnecessary and undesired for the user and increase the signalling load of the network without cause. In particular areas of the network, for instance at the edge of a private network, signals of other networks are so strong that the MS may try to perform a location updating to an external network. Such location updatings are unnecessary and annoying when the user desires to remain registered in the area of a particular network irrespective of the received signal level or other criteria. The user may, if he desires, prevent manually all location updatings and location updating attempts between the different networks and thus lock the use of the mobile station MS temporarily within the area of a particular network. The locking prevents location updatings between the networks so that the MS may roam in a selected network from a location area to another, but location updatings from one network to another (e.g. from a BCPN or DCPN to a public network or vice versa, or between two public networks or between two private networks) are not performed under any circumstances. Not even an attempt is made to update the location to a "foreign network".

The user of the mobile station MS is entitled to decide when he activates the locking function of location updating. The user may wish to remain in a particular network for instance for charging reasons in order to be able to utilize special services offered by this particular network or to prevent un-

necessary location updatings. The locking is activated manually e.g. by means of a key function or a function code, if the mobile station MS is provided with a particular function code for such a locking function.

To perform the locking function, the MS shall be capable of distinguishing the different networks from each other, which can be carried out for instance in such a manner that the base stations BS of the cellular network broadcast, except the identifiers LAI, BSI, BSTI etc. mentioned earlier, also a network-specific "locking code". Thus all base stations of the same network broadcast the same locking code. In Figure 1 for instance, the base stations BS of the public primary network send a locking code (1000), the BCPN<sub>1</sub> sends a locking code (0111), the BCPN<sub>2</sub> sends a locking code (1001), the DCPN<sub>1</sub> sends a locking code (0101) and the DCPN<sub>2</sub> sends a locking code (1111).

Another alternative is that the information broadcasted by the base stations BS contains the identifier of that network to which the base station belongs or said identifier may be derived from the broadcasted information. Such an identifier may be formed for instance by means of the Base Station Identifier BSI and the Base Station Type Identifier BSTI.

When the user activates, preferably manually, the locking function of location updating of an MS, the MS stores the locking code sent by the current BS or the identifier of the network in a memory. In Figure 1 for instance, the MS locked to the BS of the BCPN<sub>2</sub> stores the locking code (1001) of said network in the activation situation. To facilitate the procedure of being locked to a correct network, the net-

work used at present may be indicated by the MS to the user in a suitable manner, e.g. by presenting the name of the network on the display, by means of particular indicator lights, etc.

5           When the MS after this moves in the area of the BCPN<sub>2</sub>, it still observes the information sent by other networks, e.g. the primary network and the base stations BS of the BCPN<sub>1</sub>. The MS monitors in a normal manner the quality of signals sent by the neighbouring base stations BS and selects, when the field strength of the present base station becomes weaker, on the basis of predetermined criteria a new base station to which it might register to. If the Location Area Identifier LAI received from the new base station BS is the same as that of the present base station, the location area does not change and a base station handover may be performed normally. If the MS observes that the location area identifier received from the new base station differs from the location area identifier LAI of the present base station BS, i.e. it observes a change of location area, the MS does not start updating the location immediately, but compares the stored locking code/network identifier at first with the locking code/network identifier received from the new base station. If the stored locking code/network identifier and the received locking code/network identifier are identical, the MS initiates the location updating, because the area in question is still the same network area to which the location updating is locked. If the stored locking code/network identifier differs from the received locking code/network identifier, the MS identifies the new base station BS as a base station of a "foreign network" and the location updating is not initiated. In Figure 1 for instance, the locking of lo-

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cation updating is activated by MS in the network BSPN<sub>2</sub>, and consequently, the MS performs a location updating when it moves from a base station to another within the BCPN<sub>2</sub>, but does not under any circumstances perform a location updating for instance via the base stations of the primary network (locking code 1000) or the base stations of the BCPN<sub>1</sub> (locking code 0111), since they have different locking codes.

The locking function may be a voluntary function, which is not necessarily supported by all networks, and for this reason, they do not broadcast any locking code at all. In such a situation the MS, in which the locking of location updating is activated, interpretes the missing locking code as a different code and does not initiate the location updating.

If a location updating is prevented according to the invention at some base station, the MS remains registered to the present base station or selects by means of specific criteria the next best base station and takes the measures according to the invention also for this new base station.

The locking of location updating remains activated, until the user deactivates it. After the deactivation of the locking, all location updating attempts also between different networks are performed in a conventional manner.

When comparing the above alternative manners of implementation, the use of locking code may be considered more limited, because it lengthens messages sent by the base station BS and a locking code cannot actually be used for other purposes. For the MS, it may be the more uncomplicated alternative. Another case, in which the network identifier can be derived from the base station identifier BSI, for instance, is preferable, because the base station identifier is

generally utilized for other functions as well and is thus sent anyway. The cellular network is thus not supposed to have any new functionality, but the implementation of the locking function depends on the functionality of the mobile station MS only. For the MS, this alternative may be more complicated. However, the function according to the invention can be implemented in both cases also in mobile terminals available at present by relatively minor changes in software.

Figure 2 shows a general block diagram of one mobile station MS, to which the invention may be applied. The MS comprises a transceiver 21 connected to an antenna 27, in which transceiver the receiver is connected via digital-analog and base frequency circuits 23 to a loudspeaker 25 and in which the transmitter is connected via analog-digital converter and base frequency circuits 24 to a microphone 26. The operation of the MS is controlled by a microprocessor 22 processing the signalling sent and received by the transceiver. A user interface comprises a display 28 and a keyboard 29, which are connected to the microprocessor 22. The invention may be realized by changing the software of the microprocessor 22 in such a way that it performs the inventive functions described above.

The figure and the description associated with it are only intended to illustrate the present invention. As to the details, the cellular radio network according to the invention may vary within the scope and spirit of the attached claims.

## Claims:

1. A cellular radio network comprising  
a primary network having a first location area  
5 configuration,  
mobile radio stations (MS) capable of moving in  
the primary network from one location area to an-  
other, a mobile station starting a location updating  
procedure in the cellular network each time a change-  
10 over from one location area of the primary network to  
another is observed,  
c h a r a c t e r i z e d in that  
at least part of the mobile stations (MS) are  
capable of moving, except in the primary network, in  
15 at least one other network (BCPN1-2, DCPN1-2) having  
a second location area configuration differing from  
said first location area configuration, and that  
the mobile radio station (MS) comprises means  
(22), which, when activated by the user, temporarily  
20 prevent the mobile radio station from initiating lo-  
cation updatings to other networks from the network  
used at the time of activation.
2. A cellular radio network according to claim  
1, c h a r a c t e r i z e d in that said at least  
25 one other network comprises at least one complemen-  
tary network (BCPN1-2, DCPN1-2) having a second loca-  
tion area configuration differing from said first  
location area configuration, and that the mobile  
radio stations (MS) are capable of moving in the pri-  
30 mary network and said at least one complementary net-  
work (BCPN1-2, DCPN1-2) and between them.
3. A cellular radio network according to claim  
1 or 2, c h a r a c t e r i z e d in that the base  
stations (BS) of the primary network and the base  
35 stations (BS) of said at least one other network

(BCPN1-2, DCPN1-2) send network configuration information, and that a network identifier is contained in or derived from said network configuration information and that a mobile station (MS) is capable of distinguishing the location areas of the primary network and said at least one other network from each other by means of said network identifier.

4. A cellular radio network according to claim 1, characterized in that means (22) for preventing location updating are responsive to a manual activation by the user for storing a network identifier of the current network in a memory,

the means (22) for preventing location updating are responsive to an observation of a change of location area for comparing the stored network identifier with a network identifier received in the network configuration information from the base station of the new location area and

a) for allowing location updating if the network identifiers are identical,

b) for preventing location updating if the network identifiers are different.

5. A cellular radio network according to claim 1, characterized in that a transmission of the base stations (BS) of the primary network contains a first locking code and a transmission of the base stations (BS) of said at least one other network (BCPN1-2, DCPN1-2) contains a second locking code, and that said preventing means (22) of the mobile station (MS) are capable of distinguishing the location areas of the primary network and said at least one other network from each other by means of said locking codes.

6. A cellular radio network according to claim



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5, c h a r a c t e r i z e d i n t h a t

the means (22) for preventing location updating are responsive to a manual activation by the user for storing the locking code sent by the present network in a memory,

the means (22) for preventing location updating are responsive to an observation of a change of location area for comparing the stored locking code with a locking code received from the base station of the new location area and

a) for allowing location updating if the locking codes are identical,

b) for preventing location updating if the locking codes are different or the base station of the new location area sends no locking code at all.

7. A cellular radio system according to claim 1, c h a r a c t e r i z e d i n t h a t with the means (22) for preventing location updating unactivated, the mobile station (MS) initiates a location updating procedure each time when it moves from one location area to another.

8. A mobile radio station (MS) for a cellular radio network comprising a primary network having a first location area configuration, the mobile radio station (MS) being capable of moving in the primary network from one location area to another and starting a location updating procedure in the cellular network each time a changeover from one location area of the primary network to another is observed,

c h a r a c t e r i z e d i n t h a t

the mobile station (MS) is capable of moving, except in the primary network, in at least one other network (BCPN1-2, DCPN1-2) having a second location area configuration differing from said first location area configuration, and that

the mobile radio station (MS) comprises means (22), which, responsive to an activation by the user, temporarily prevent the mobile station from initiating location updatings to other networks from the network used at the time of activation.

5  
9. A mobile radio station according to claim 8, characterized in that the means (22) for preventing location updating are capable of distinguishing the location areas of the different networks from each other by means of different locking codes sent by the base stations of the primary network and said at least one other network,

the means (22) for preventing location updating are responsive to a manual activation by the user for storing a locking code sent by the present network in a memory, and that

the means (22) for preventing location updating are responsive to an observation of a change of location area for comparing the stored locking code with a locking code received from the base station of the new location area and

a) for allowing location updating if the locking codes are identical,

b) for preventing location updating if the locking codes are different or the base station of the new location area sends no locking code at all.

10. A mobile radio station according to claim 8, characterized in that

the mobile radio station (MS) is capable of distinguishing the location areas of the primary network and said at least one other network (BCPN1-2, DCPN1-2) from each other by means of a network identifier contained in or derived from the network configuration information sent by the base stations (BS),

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the means (22) for preventing location updating are responsive to an activation by the user for storing the identifier of the present network in a memory, and that

5       the means (22) for preventing location updating are responsive to an observation of a change of location area for comparing the stored network identifier with a network identifier received from the network configuration information sent the base station of  
10       the new location area and

a) for allowing location updating if the network identifiers are identical,

b) for preventing location updating if the network identifiers are different.

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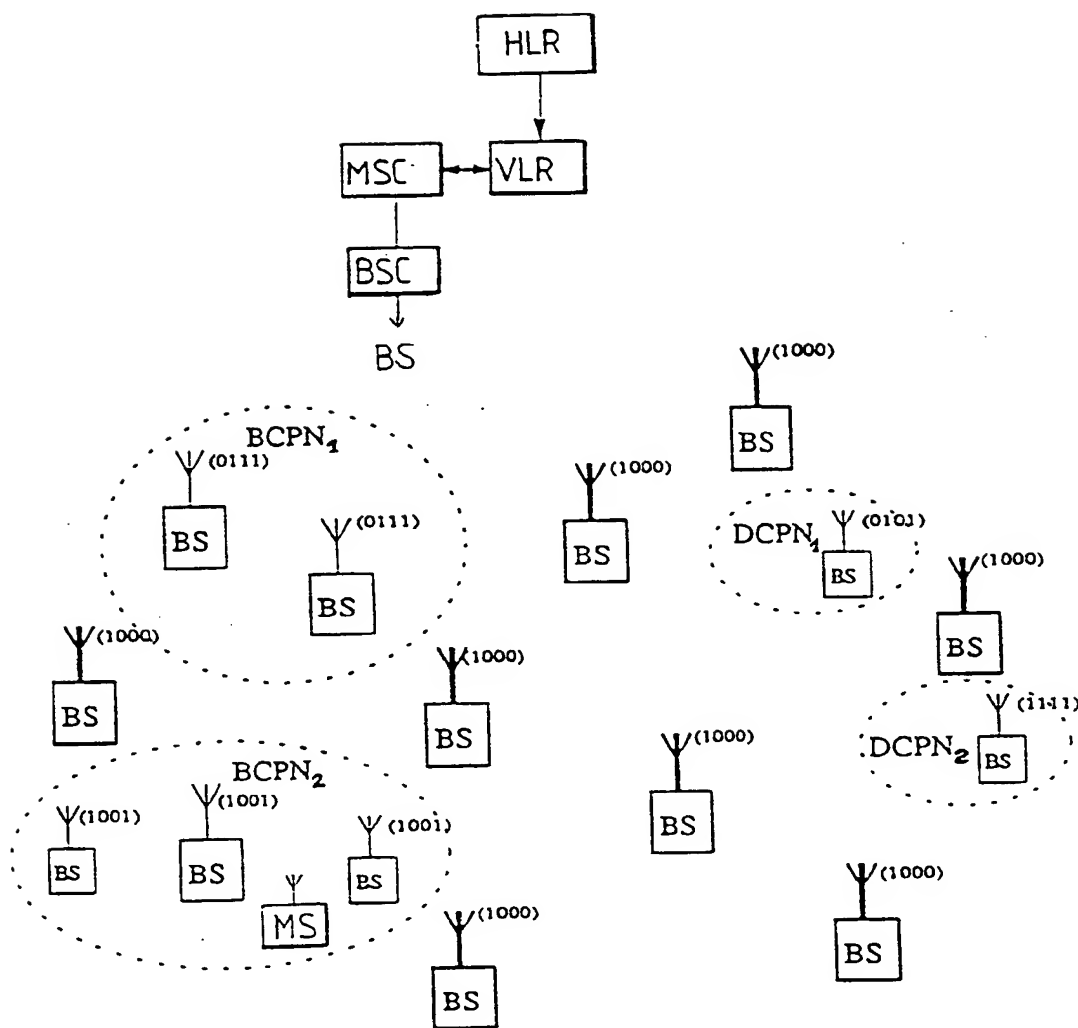


FIG. 1

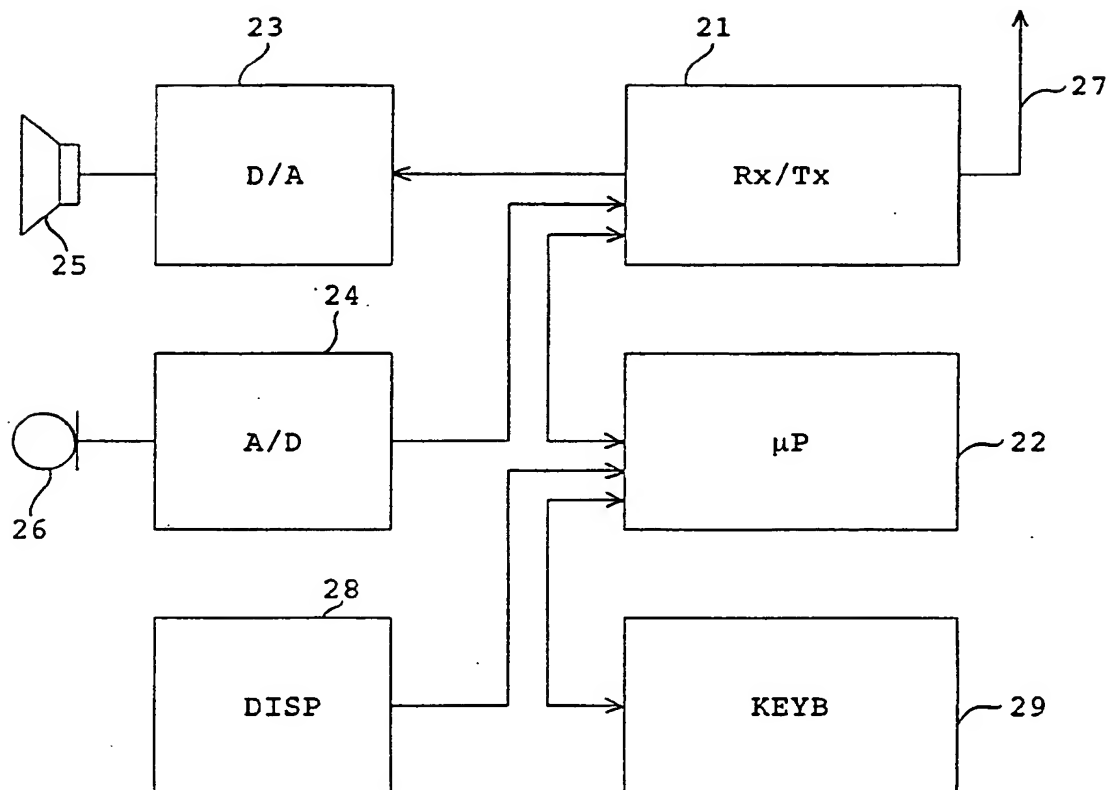


FIG. 2

# INTERNATIONAL SEARCH REPORT

1

International application No.

PCT/FI 93/00360

## A. CLASSIFICATION OF SUBJECT MATTER

IPC5: H04B 7/26

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: H04B, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP, A1, 0465444 (TELEFONAKTIEBOLAGET L M ERICSSON), 8 January 1992 (08.01.92), abstract	1-3
A	--	4-10
Y	WO, A1, 9219078 (COMVIK GSM AB), 29 October 1992 (29.10.92), abstract	1-3
A	--	4-10
Y	EP, A1, 0439628 (NIPPON TELEGRAPH AND TELEPHONE CORPORATION), 7 August 1991 (07.08.91), abstract	1-3
A	--	4-10



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

Date of mailing of the international search report

10 December 1993

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 93/00360

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE, A1, 4107998 (AEG MOBILE COMMUNICATION GMBH), 17 Sept 1992 (17.09.92), the whole document  ----- --	1-10

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

16/10/93

International application No.  
PCT/FI 93/00360

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